AN ANALYSIS OF THE MARKET POTENTIAL FOR DISTANCE LEARNING OPPORTUNITIES IN TRANSPORTATION PROFESSIONAL DEVELOPMENT

By

Brooke R. Durkop
Texas Transportation Institute
3135 TAMU
College Station, TX 77843-3135
Phone: (979) 862-6636
Fax: (979) 845-9873
E-Mail: b-durkop@tamu.edu

Debbie Jasek
Texas Transportation Institute
3135 TAMU
College Station, TX 77843-3135
Phone: (979) 845-5239
Fax: (979) 845-9873
E-Mail: d-jasek@tamu.edu

Beverly T. Kuhn, Ph.D., P.E.
Texas Transportation Institute
3135 TAMU
College Station, TX 77843-3135
Phone: (979) 862-3558
Fax: (979) 845-9873
E-Mail: b-kuhn@tamu.edu

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16. Abstract

One in seven jobs in the United States is related to the transportation industry and qualified employees are in high demand for these positions. The increased use of advanced technologies in transportation and the monumental leaps in the use of technology in all aspects of life has created a dilemma for transportation professionals. This dilemma is to find employees capable of working within this new technology influenced arena. Furthermore, the skills required of the transportation workforce are constantly changing and becoming more complex and diverse. Thus, there is also a need to enhance the knowledge, skills, and abilities (KSAs) of current transportation professionals. Distance learning is an attractive means of enhancing KSAs because students are provided with the opportunity of anytime, anywhere learning. Additionally, the potential audience for distance learning courses is not limited to a specific region.

This research investigated the feasibility and sustainability of a distance learning program at the Texas Transportation Institute through the Center for Professional Development. Through a literature review and an on-line questionnaire completed by current transportation professionals, the research examined the market potential for a distance learning program, including those engineering topics that are in high demand within various transportation organizations. Some other issues that the research addressed included an individual's willingness to pay for courses, potential frequency of participation, and preferred course delivery medium. The results yielded a determination of the feasibility and sustainability of such a program and a prioritized list of topics that will provide direction in the initiation of a transportation-related distance learning program.

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ABSTRACT

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This research investigated the feasibility and sustainability of a distance learning program at the Texas Transportation Institute through the Center for Professional Development. Through a literature review and an on-line questionnaire, the research examined the market potential for a distance learning program, including those engineering topics that are in high demand within various transportation organizations. Some other issues that the research addressed included an individual's willingness to pay for courses, potential frequency of participation, and preferred course delivery medium. The results yielded a determination of the feasibility and sustainability of such a program and a prioritized list of topics that will provide direction in the initiation of a transportation-related distance learning program.

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EXECUTIVE SUMMARY

One in seven jobs in the United States is related to the transportation industry and qualified employees are in high demand for these positions. The increased use of advanced technologies in transportation has created a dilemma for transportation professionals. This dilemma is to find employees capable of working within this new technology influenced arena. Furthermore, the skills required of the transportation workforce are constantly changing and becoming more complex and diverse. Distance learning is an attractive means of enhancing the knowledge, skills, and abilities (KSAs) because students are provided with the opportunity of anytime, anywhere learning.

Through a literature review and an on-line questionnaire, completed by current transportation professionals, the market potential for a distance learning program was examined. Some issues addressed by the questionnaire included an individual's willingness to pay for courses, potential frequency of participation, course topics, and preferred course delivery medium.

The examination of the questionnaire responses indicated that respondents have an overall good perception of the need for continuing education in the transportation field, and that the establishment of a distance learning program is a viable means of presenting these courses. The respondents were asked to select from a list of 15 possible topics of interest for continuing education courses. They were allowed to select as many responses as they felt were appropriate and were also given "other" as an option with space to further clarify this response. The analysis of these responses indicated that there

is a diverse field of interest within the transportation community for continuing education. However, the most desired topic was traffic engineering, followed closely by modeling/simulation and intelligent transportation system (ITS) courses.

A critical topic in the consideration of feasibility and sustainability for a program is the fee that a participant is willing to pay for a distance learning course. The preferred fees given for distance learning courses tend to be lower than those currently found for conventional continuing education courses. A further analysis of course fees is important to ensure sustainability of the distance learning program. The next step in the establishment of a distance learning program is to develop a pilot course that meets one of the needs expressed by the transportation professionals. This pilot course would be tested for usability and appeal to the target market.

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I. INTRODUCTION

In today's world of rapidly changing technology and escalating competition, employers are finding it increasingly difficult to keep their workforces technologically current and well trained. Furthermore, time, distance, travel costs, and other constraints on workers have made traditional approaches to training more difficult. By using technology such as computers and telecommunications, knowledge experts can use innovative approaches to deliver training and education to those who need or desire it. These new approaches include "just in time" delivery of critical information where and when it is needed, at the appropriate and desired level of detail, and in a format preferred by the user. Avoiding excessive and extraneous information ensures that the education workload for the user is manageable and meaningful. One of the approaches for this type of learning environment is termed distance learning.

Research Objectives

The purpose of this research was to investigate the feasibility and potential sustainability of developing a distance learning program at the Texas Transportation Institute (TTI) through the Center for Professional Development (CPD). The research identified the potential market for distance learning opportunities provided by the Center to transportation professionals, both within the Southwest Region University Transportation Center (SWUTC) region and nationwide. The research also identified

those transportation-related topics that are critically needed by that market and will most likely generate interest and support for a distance learning program.

II. LITERATURE REVIEW

Quite simply, distance learning is any type of education that occurs when location, time, or both separate the participants. In distance learning, the teacher, through the use of technology, delivers instruction to a student at a separate location. The teacher then receives feedback, either immediate or delayed, from the student. Contrary to popular opinion, distance learning does not have to be "high tech." A classic correspondence course in which printed materials are mailed to the student and returned to the teacher is distance learning. In fact this method, which utilizes the postal system, was the original form of distance learning. Distance learning may utilize any individual or combination of the following four technologies:

- Printed materials;
- Audio/Voice technologies;
- Computer technologies; and
- Video technologies

Types Of Distance Learning

Distance learning may be roughly divided into two delivery types - synchronous and asynchronous. Synchronous learning implies that the student and trainer interact with each other in real time, while asynchronous learning relies on delayed feedback. Distance learning that utilizes printed materials exclusively is always asynchronous,

although utilization of faxes or electronic mail minimizes the delay between interactions. Audio, computer, and video technologies may be used for either synchronous or asynchronous distance learning. Table 1 outlines synchronous and asynchronous delivery methods of distance learning utilizing various technologies.

Table 1. Examples of Synchronous and Asynchronous Delivery.

Technology	Synchronous	Asynchronous
Printed Material	None	Self Paced Textbooks Correspondence Course
Audio/Voice	Audio conferencing Telephone	Audiotape Radio
Computer	Chatroom Desktop video conference	E-mail CD-ROM Bulletin Board
Video	Video conferencing	Videotape Television Broadcast

III. STUDY DESIGN

The intent of this study was to determine the professional development needs, with regard to distance learning, of current professionals in the arena of transportation. The study team determined that an on-line questionnaire would be an effective method for gathering input from the target audience. An initial study questionnaire was distributed during the 2000 TransLink® Partners Meeting to receive feedback and to ensure that the study was gathering the appropriate information for analysis and decision making by the researchers. A copy of this initial questionnaire was also given to the external project advisor. The intent was to receive her input regarding essential questions and format based on her expertise in the continuing education field.

Based on the feedback received from these two sources, the study team refined the questionnaire and made it available on-line through the TTI website to gather information from professionals nationwide. The study targeted professionals within all interest areas and career paths of transportation. Team members sent messages to professional societies and organizations within the transportation community via email to encourage them to complete the questionnaire. The original messages were sent to 11 different listserv groups with approximately 1500 recipients total. A copy of the on-line questionnaire is located in the Appendix A. Also included in Appendix A are the definitions given for certain key terms within the questionnaire.

Study responses were collected over a three month period to allow adequate time for participation. Once the participant had completed the on-line questionnaire, the data

was automatically stored in a database. Electronic safeguards were put into place so that a person could not complete the questionnaire more than once. Also, the responses were stored such that all identifying information was removed, and the responses were completely anonymous.

The study team analyzed the collected data to identify the general needs of the audience with regards to professional development and distance learning. Information was gathered regarding familiarity with continuing education and distance learning, topics of interest to the transportation community, and demographic information such as employment and computer availability and usage.

IV. RESULTS

The on-line questionnaire collected 209 responses, during the three month period that it was available. This response rate constitutes approximately 14 percent of the original message recipients, which is considered acceptable for the blind questionnaire format. The raw results for this study can be found in Appendix B.

The volunteers who participated were primarily full-time employees within the transportation profession. Table 2 provides a breakdown of the types of organizations where the participants were employed. Also, it should be noted that the participants in this study were distributed almost equally among experience levels from less than 5 years to greater than 20 years of experience.

Table 2. Type of Organization Where Study Participants are Employed.

Organization	Number of Participants	Percentage (%)
Consultant	61	29
Educational Institution	41	20
Municipal Department of Transportation	29	13
State Department of Transportation	23	11
County Department of Transportation	10	5
Research Establishment	10	5
Metropolitan Planning Organization	9	4
Federal Agency	6	4
Systems Integrator	3	1
Automotive Manufacturer	3	1
Vendor	2	1
Public Transit Agency	2	1
Other	10	5

Another area of interest to the researchers was the availability of computers and the Internet to transportation professionals. Questions were asked regarding both home and work computer access. Responses indicated that all of the participants have computers at work, and 91 percent have computers at home. The majority of those with available computers have access to the Internet (99% at work and 96% at home). However, these results are most likely biased as the questionnaire was distributed and completed electronically. Despite this recognized bias, the fact that computers are readily available to individuals within the transportation profession creates a viable conduit for the exchange of information during the process of distance learning. Further information regarding these computer systems is that the majority of them are PC based systems (98 percent at work, 94 percent at home), and have a CD-ROM as a component of this system (95 percent at work, 97 percent at home). These features are important to consider when determining delivery methods that could be employed for distance learning.

General Continuing Education

In response to the questions regarding continuing education within the participant's organizations, 96 percent responded that either they, or someone in their organization, had taken a continuing education course. It was the perception of the participants in this study that continuing education courses are beneficial to employees within their organizations in many ways. The most frequently cited benefit in this study was increased responsibility within the organization.

The responses indicated that 96 percent of the organizations employing the study participants give some form of support for continuing education. Financial reimbursement, or financial reimbursement and leave, are the most common ways that an employer encourages participation in continuing education. This support by the employer is a major factor in a person's ability to participate in these courses.

The participants' desire to take part in continuing education opportunities can be seen in their ranking of need for continuing education as high or medium, indicating that they believe it would benefit them in their future work, or that it was mandated for graduation or employment. However, sending a large number of employees to a training course at a location is often not feasible due to the limited amount of travel funds available for this purpose. To make continuing education opportunities readily available to employees, these courses need to be made available in-house. Currently, less than 50 percent of the employers in this study provide in-house continuing education opportunities to their employees on a regular basis. This indicates that other formats beyond the traditional classroom format should be investigated to expand the learning opportunities available to transportation professionals.

General Distance Learning

Familiarity with the concept of distance learning was fairly high among the participants in this study (88 percent), but only a small percentage of the participants knew employees within their organization participating in such courses (35 percent).

The viability of a distance learning program as a continuing education opportunity within the transportation community can best be indicated based on the importance of the conventional classroom format to individuals within this profession. In this study, the majority of the participants (84 percent) said that a conventional classroom format was only somewhat important or not important to them in continuing education. Only 16 percent of participants thought that it was very important to participate within a conventional classroom situation. Based on these results, it would appear that the use of distance learning techniques would be well accepted by the target audience, the transportation profession.

Further questions investigated the frequency with which the respondents would like to participate in distance learning opportunities. In response to this, the majority of the participants (75 percent) stated that they would be interested in participating once or twice a year, with only seven percent indicated that they would never be interested in such courses.

One of the key points for this study was to determine the preferred method of participation for distance learning within the transportation profession. Table 3 contains the responses to this question. In the responses, the rankings were given as 1 being the favorite option and 4 being the least favorite option. The "Ranking Sum" was calculated by summing the rankings given for each option. Using this method, the preferred option in the table would have the lowest "Ranking Sum".

Table 3. Preferred Method for Distance Learning Participation

Ranking	Participation Options		
	Interactive Video	On-line Courses	CD-ROM Courses
1 (Favorite)	20	39	20
2	51	63	68
3	56	39	46
4 (Least Favorite)	27	14	24
0 (Not Sure)	54	53	50
Ranking Sum	398	338	390

On-line courses received the overall best ranking for preferred method of participation. However, both interactive video and CD-ROM based courses were also frequently selected and would provide good alternatives when students do not have access to the Internet. The divided responses indicate that all three methods would be well received as possible tools for distance learning courses.

Distance Learning Course Topics

Further aspects of distance learning sustainability that was explored during this study were:

- the need for particular topics in continuing education, and
- the perceived current topic opportunities within the area of transportation.

It was the perception of 71 percent of the study participants that continuing education courses already exist that are specifically tailored to transportation. Some of the examples provided of such courses included: engineering courses, university offered

continuing education, seminars at professional organization meetings, software courses, and many more varied responses. Several people simply stated that too many exist to list.

When taken in conjunction with the results presented earlier, the survey indicates that while there are a large number of opportunities available to transportation professionals, most of the profession is not taking advantage of the opportunities. This raises the question of would distance learning make them more accessible to the profession as a whole?

When the participants were asked to select topics that they believed were of significant need to the transportation community for distance learning opportunities, the most frequent response was traffic engineering courses, followed by modeling/simulation software, and ITS courses. Table 4 lists all of the available topics that were given as options in the survey, and the percentage of participants who selected each individual option. It should be noted, that participants could select more than one topic for this question.

Table 4. Continuing Education Topics Needed in Transportation.

Topic	Percentage of Responses (%)
Traffic Engineering	71%
Modeling / Simulation Software	58%
Intelligent Transportation Systems	54%
Analysis Software	47%
Strategic Planning	36%
Telecommunications	33%
Systems Engineering	32%
Other	29%
Contract Management	27%
Incident Management	25%
Systems Architecture	22%
Environmental Management	20%
Financial Management	20%
Grants Management	17%
Emergency Management	15%

Within the 29 percent of the responses that included "Other," some of the trends regarding additional topics included: human factors in transportation, communication skills (including technical writing, public speaking, etc.), and roadway and structural design courses.

Continuing Education Units (CEUs)

Although most of the study participants were familiar with CEUs, only 15 percent of the employers used them for promotion/salary increase. Forty-two percent stated that CEUs were required for their professional certifications. It is the feeling of the researchers that this percentage will continue to increase as more professional

certifications or employers within the transportation field begin requiring CEUs for continued licensing and/or employment.

CEUs can be a driving force behind the need for continuing education and, more specifically, distance learning. Through distance learning, individuals are able to earn CEUs without having to take leave from work and, in many cases, are also able to complete courses at their own pace and time convenience.

Though it appears that most employers reimburse employees for continuing education costs, fees for the courses are still a major issue in establishing a successful distance learning program. Table 5 shows the breakdown of study participants' opinions about the fees that should be associated with distance learning courses. The number within each box indicates the number of respondents who would pay the given fee for a course of the specified duration. For example, 45 respondents indicated a willingness to pay $500 for a 4 day (3.2 CEU) course.

Table 5. Distance Learning Course Fees

Length of Course (CEUs)	$200	$300	$400	$500	$600	$700	$800	$900	Not Sure
1 day (0.8 CEUs)	102	24	1						82
2 day (1.6 CEUs)		71	50	4					84
3 day (2.4 CEUs)*			10	15	4				23
4 day (3.2 CEUs)				45	44	16			104
5 day (4.0 CEUs)						55	33	14	98

* Partial data was lost due to database error.

Table 5 shows that the preferred fees given in these responses tend to be lower than those currently found for conventional continuing education courses. Traditional courses, with an instructor, cost more to produce and offer than stand-alone, self-paced course. The lower costs associated with distance learning make it feasible to provide these courses at the indicated lower fees, depending on both the nature and delivery method of the course. This may be an incentive to employers in encouraging distance learning as a preferred continuing education opportunity.

Further examination of the survey responses regarding acceptable fees shows that a large number of the respondents answered "not sure". This response could be due to the significant number of employers who are financially supporting employee participation in continuing education courses. As a result of this support, survey respondents may not be fully aware of the cost issues surrounding distance learning opportunities.

V. FINDINGS AND RECOMMENDATIONS

Based on the analysis of the study questionnaire, respondents have an overall good perception of continuing education opportunities within the field of transportation. This positive background bodes well for the feasibility and potential sustainability of a transportation distance learning program at the Texas Transportation Institute. The following points should be considered in the establishment of this program.

1. The preference of the study participants leaned slightly towards the use of on-line course techniques. However, because this format is not accessible for all potential students, and there were close rankings for all three alternatives provided, interactive video or CD-ROM based courses are also potential media for distributing information. One issue that should be further examined is that a large number of the participants selected "Not Sure" when asked what learning format they preferred. The researchers believe that this finding could be attributed to a lack of experience with distance learning formats and that participant feedback during the administration of courses would be necessary to gauge participant opinion as experience increases.

2. The majority of respondents indicated a desire to participate in distance learning courses once or twice a year.

3. While the awareness of distance learning opportunities is high, a relatively low number of respondents indicated that they, or a co-worker, had participated in such opportunities. These results indicate that alternative methodologies and subject material may provide a viable basis for a distance learning program.

4. The most urgent curriculum need, based on participant response, is for traffic engineering courses, followed closely by modeling/simulation courses and ITS courses. However, responses also indicated diverse needs with regard to curriculum in a distance learning program.

The next step in the establishment of a distance learning program is to develop a pilot course that meets a need expressed by the transportation professionals. This pilot course would be tested for usability and appeal to the target market. Furthermore, an in-depth analysis of course fees associated with this effort is important to ensure sustainability of the distance learning program.

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APPENDIX A

QUESTIONNAIRE

Section 1: Distance Learning and Your Organization
(16 questions - approximately 5 minutes)

1) Have you, or any member of your organization, attended or taken a continuing education course?

- ✓ Yes
- ✓ No

1a) If *Yes*, what percentage of people in your organization have?

- ✓ Less than 25 percent
- ✓ 25 to 50 percent
- ✓ 50 to 75 percent
- ✓ More than 75 percent

2) Does your organization support continuing education?

- ✓ Yes
- ✓ No

2a) If *Yes* in what manner does your organization support continuing education?
Please select all that apply - (Hint: Hold down the CTRL key to make multiple selections)

- ✓ Financial
- ✓ Reimbursement
- ✓ Leave
- ✓ Other

If you answered *Other* in Question 2a above, please list what other types of support they have.

3) In your opinion, do staff in your organization benefit from continuing education?

- ✓ Yes
- ✓ No

3a) If *Yes*, how do they benefit?
Please select all that apply - (Hint: Hold down the CTRL key to make multiple selections)

- ✓ Increased Responsibility
- ✓ Promotion
- ✓ Salary Increase
- ✓ Other

If you answered *Other* in Question 3a above, please list what other benefits they receive.

4) Does your organization currently provide in-house training and development on a regular and continuing basis?

- ✓ Yes
- ✓ No
- ✓ Occasionally

5) Your need to take continuing education is?

- ✓ High - You need them for graduation and/or your job
- ✓ Medium - They might benefit you in the future
- ✓ Low - Would only be for personal interest

6) Are there continuing education courses that are specifically tailored for your field of employment?

- ✓ Yes
- ✓ No

If you answered *Yes* in Question 6 above, please list what courses are available.

7) In your organization, what are the topics that you feel are of significant need to you, your staff, or in the transportation community at large?
Please select all that apply - (Hint: Hold down the CTRL key to make multiple selections)

- ✓ Traffic Engineering
- ✓ ITS
- ✓ Systems Engineering
- ✓ Modeling / Simulation Software
- ✓ Analysis Software
- ✓ Telecommunications
- ✓ Systems Architecture
- ✓ Environmental Management
- ✓ Incident Management
- ✓ Emergency Management
- ✓ Financial Management
- ✓ Contract Management
- ✓ Grants Management
- ✓ Strategic Planning
- ✓ Other

If you answered *Other* in Question 7 above, please list what courses you feel are of significant need.

8) In continuing education, how important is it to be part of a conventional class?

- ✓ Very Important
- ✓ Somewhat Important
- ✓ Not Important

9) Are you familiar with Distance Learning?

- ✓ Yes
- ✓ No

10) Have you, or any member of your organization, obtained degrees, certification, continuing education, or workforce development via distance learning?

- ✓ Yes
- ✓ No

10a) If *Yes*, what percentage of people in your organization have?

- ✓ Less than 25 percent
- ✓ 25 to 50 percent
- ✓ 50 to 75 percent
- ✓ More than 75 percent

11) If you were to take a distance learning course, which method would you prefer to use when participating?
Please rank from 1 (favorite) to 4 (least favorite)

a) Interactive Video	1 2 3 4	Not Sure
b) On-line Courses	1 2 3 4	Not Sure
c) CD-ROM Based Courses	1 2 3 4	Not Sure

12) How often would you be interested in participating in a distance learning course regarding transportation continuing education?

- ✓ Once a year
- ✓ Twice a year
- ✓ Three times a year
- ✓ Four to six times a year
- ✓ More than six times per year
- ✓ Never

13) Are you familiar with Continuing Education Units (CEUs)

- ✓ Yes
- ✓ No

14) Does your company use CEUs for promotional/salary increase purposes?

- ✓ Yes
- ✓ No

15) Are you required to obtain CEUs to maintain a professional certification?

- ✓ Yes
- ✓ No

16) What do you consider a reasonable fee for a course offered via distance learning? *(remember, 1 CEU is equivalent to 10 PDHs)*

a) 1-day course (0.8 CEUs)	$200 $300 $400	Not Sure
b) 2-day course (1.6 CEUs)	$300 $400 $500	Not Sure
c) 3-day course (2.4CEUs)	$400 $500 $600	Not Sure
d) 4-day course (3.2 CEUs)	$500 $600 $700	Not Sure
d) 5-day course (4.0 CEUs)	$700 $800 $900	Not Sure

Section 2: Demographic Information
(7 questions - approximately 3 minutes)

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17) What is your highest level of education?

- ✓ High School
- ✓ Associate Degree / Technical (Vocational) Education
- ✓ Bachelor's Degree
- ✓ Master's Degree
- ✓ Doctoral Degree
- ✓ Other / Decline to answer

- ✓

18) What is your employment status?

- ✓ Full-time
- ✓ Part-time
- ✓ Student
- ✓ Retired
- ✓ Other / Decline to answer

19) How many years of transportation-related experience do you have?

- ✓ Less than 5 years
- ✓ 5-10 years

- ✓ 10-15 years
- ✓ 15-20 years
- ✓ More than 20 years

20) What type of organization do you work for?

- ✓ State Department of Transportation
- ✓ Municipal Transportation Department
- ✓ County Transportation Department
- ✓ Metropolitan Planning Organization
- ✓ Consultant
- ✓ Federal Agency
- ✓ Toll Road Authority
- ✓ Public Transit Agency
- ✓ Law Enforcement
- ✓ Systems Integrator
- ✓ Educational Institution
- ✓ Research Establishment
- ✓ Automotive Manufacturer
- ✓ Vendor
- ✓ Other

If you answered *Other* in Question 20 above, please list what type of organization you work for.

21) In which state/province do you work??

Select State/Province

22) What is your position with your organization?

23) What professional certifications you you have?

Please select all that apply - (Hint: Hold down the CTRL key to make multiple selections)

- ✓ Professional Engineer
- ✓ Professional Traffic Operations Engineer
- ✓ Project Manager
- ✓ Professional Engineer-In-Training
- ✓ None
- ✓ Other

If you answered *Other* in Question 23 above, please list what certifications you hold.

Section 3: Your Available Computer Technology
(10 questions - approximately 4 minutes)

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24) Do you have access to a computer at work?
If the answer is "No", please go to Question 28

- ✓ Yes
- ✓ No

25) Does your computer at work have Internet access?

- ✓ Yes
- ✓ No

25a) How do you connect to the Internet at work?

- ✓ Dial-up modem
- ✓ ISDN (Integrated Digital Subscriber Network)
- ✓ DSL (Digital Subscriber Line)
- ✓ Cable Modem
- ✓ Corporate LAN
- ✓ I'm Not Sure

26) Does your computer at work have a CD-ROM?

- ✓ Yes
- ✓ No

27) What type of computer do you have at work?

- ✓ PC
- ✓ Mac
- ✓ Other/Not Sure

28) On what platform does your computer at work operate?

- ✓ Windows 95/98
- ✓ Windows NT/2000
- ✓ Apple Macintosh System 6 or higher
- ✓ Sun Solaris
- ✓ Linux
- ✓ Other / Don't Know

29) Do you have access to a computer at home?
If the answer is "No", please go to the end of the survey

- ✓ Yes
- ✓ No

30) Does your computer at home have Internet access?

- ✓ Yes
- ✓ No

30a) How do you connect to the Internet at home?

- ✓ Dial-up modem
- ✓ ISDN (Integrated Digital Subscriber Network)
- ✓ DSL (Digital Subscriber Line)
- ✓ Cable Modem
- ✓ I'm Not Sure

31) Does your computer at home have a CD-ROM?

- ✓ Yes
- ✓ No

32) What type of computer do you have at home?

- ✓ PC
- ✓ Mac
- ✓ Other/Not Sure

33) On what platform does your computer at home operate?

- ✓ Windows 95/98
- ✓ Windows NT/2000
- ✓ Apple Macintosh System 6 or higher
- ✓ Sun Solaris
- ✓ Linux
- ✓ Other / Don't Know

APPENDIX B

RAW RESULTS

Q1:

Responses	Number	Percentage (%)
Yes	200	96
No	9	4

Q1a:

Responses	Number	Percentage (%)
< 25%	98	47
25 – 50%	47	22
50 – 75%	33	16
> 75%	31	15

Q2:

Responses	Number	Percentage (%)
Yes	201	96
No	8	4

Q2a:

Responses	Number	Percentage (%)
Financial (F)	70	35
Leave (L)	8	4
Other (O)	6	3
F,L,O	18	9
F,L	87	43
F,O	8	4
L,O	2	1
Did Not Respond	2	1

Q2b:

Policy considers certain training CRITICAL.	Travel reimbursement, time to develop courses,
On-site classrooms for live and TV courses	Flexible schedule
Training on company time	Training, Masters program with leave and full pay
We offer CC, but not in transportation	working flex time
whatever it takes	Bring in some types of training
Sponsered Training classes at the workplace.	Provided Extra Training & First Aid Training
40hrs per calender year for outside training available	fellowships, on-site courses (distance learning)
paid working day	Both financial reimbursement or leave
Meets the requirements of an extra PD day	1/2 Financial Reimbursement
Salary Credit	Time and resources for course development
conducts it or arranges it thru contract, etc. for	We plan and present continuing education.
Inhouse Seminars	Educational instruction
Flexible hours to allow attending classes	time off for training taken during the summer
Marketing & Promotions	continuing education credit, university credit,
Development and Delivery	If time (schedules permit), travel $ is available
travel expenses	Paid as work if sancitioned by Dept
provide course for others	

Q3:

Responses	Number	Percentage (%)
Yes	205	98
No	4	2

Q3a:

Responses	Number	Percentage (%)
Increased Responsibility (I)	49	24
Promotion (P)	7	3
Salary Increase (S)	6	3
Other (O)	41	20
I,P,S	57	28
I,P	12	6
I,S	6	3
P,S	3	1
I,P,S,O	0	0
I,P,O	3	1
I,S,O	1	1
P,S,O	2	1
P,O	0	0
S,O	1	1
I,O	13	6
Did Not Respond	4	2

Q3b:

Expands work types that are performed	Increase opportunity for future trainings
Job security	Knowledge
More effective	more responsibility w/ little or no compensation
Motivation and job satisfaction	Increased Skills
Broadens projects that individual can work on.	better able to do their job
Stay up to date with the most recent technology	Increased information which may not help in job
A better understanding of what tools are available	To be informed in new technologies and development
General professional development	Knowledge
greater knowledge, better employee	Professional development (knowledge)
Increased awareness of new technology & legislation	Increased job capability, improved public confidence
Wider range of responsibilities	Improved morale
A more rounded background, personal growth	Self worth
Exposure to new methods, Professional Contacts,	Increased Job knowledge/productivity
New skills	increased knowledge & skills; employee retention
professional development	Broadened perspective, exposure to new ideas
Maintaining proficiency	Personal Achievement
They do their jobs better	Development of Expertise; Improved Performance
increased sense of their own expertise and worth	more knowledgeable so they are more marketable
I was thinking more of personal benefits	inherent benefits of additional education
have more knowledge	Improved skills
Meets C.E.U.'s for professional licensing	Networking
sense of worth - improved morale	Keeping up with industry standard skills / info
Ability to attract/retain clients	Broader knowledge and increased opportunity
Desire to increase knowledge + promotion sometimes	Better at what they do
new knowledge, contacts	Professional satisfaction of doing the job better,
Increased productivity, self-confidence, etc.	Enhanced technical knowledge
Increased Technical Skills	More valuable employee.
Cross train in other transportation areas	Increased skills, but no direct financial benefit
Knowledge	Additional Skills
Greater efficiency	Keep up with changing technology
Retention	Maintaining professional competence and licensure
Increase Productivity and Better Quality of Work	More knowledge and they do better at their jobs.
Increase knowledge	Increased professionalism
Increased competency	Professional development
Able to better do their jobs, and therefore advance	Ability to do current work better
License Req., ability to better serve the client	Knowledge gain
knowledge helps them do their job better	None of above. Just improved knowledge for future
Increases Productivity & Job Satisfaction	self-esteem, positive morale
Increased proficiency, productivity, expertise	Greater expertise, increased knowledge
Increase knowledge - professional development	Networking opportunities with other engineers
Ability to perform at a higher level	

Q4:

Responses	Number	Percentage (%)
Yes	100	48
No	52	25
Occasionally	57	27

Q5:

Responses	Number	Percentage (%)
High	78	38
Medium	105	51
Low	22	11

Q6:

Responses	Number	Percentage (%)
Yes	148	71
No	61	29

Q6a:

Seminars at professional meetings	Computer education, Highway capacity education
Many universities offer cont. edu programs	Many
Various engineering courses	Numerous courses offered by various organizations
Local university courses, conference workshops	Various topics of Civil Engineering provided by ASCE
but we need GASB 34 & benchmark contracting	Traffic engineering, Pavement maintenance
Courses are available from NHI, and TEEX.	management, transportation engineering & safety, construction
none locally - through Northwestern University	computer software application courses
Michigan State University - Civil Engineering	Forecasting, modeling, planning, design, construction
management, traffic engineering, software application	traffic signal design and maintenance, road surface
Transpeed, TransNow, Inst for Transp. Studies, GA	Too numerous to list
The DOT provides training seminars and the University	management, technical training
Transportation Engineering - there are dozens of courses	Managing Projects, Transportation related innovations
wide variety of seminars, etc. in traffic/transportation	Extra class for work site supervisor, also employee
Lots of traffic and transportation engineering courses	Courses at the Human Factors and Ergonomics Society
Project management	Consulting; computer skills
Standard Transportation and Traffic Short Courses	Planning and Implementing work Zone Traffic Control, Child Safety
Traffic Institute, software developers, manufacturing	see University of Washington - Transpeed Program
Those already offered by other universities	Traffic Engineering
Computer & Personal development courses	Many: ITE, TRB, NHI, ASCE and other universities
NHS Courses, Northwestern Univ. Traffic Institute	NUMEROUS human factors and computing courses through local universities
too many - traffic engineering course by Northwestern	many Transportation Planning related courses offered by many agencies/organizations/associations
too many to list	not sure
Northwestern offers a series of courses	Too many to name.
Transportation planning and engineering	traffic engineering, project management
There are too many to list.	School Bus Transportation Management; School Bus Transportation Supervision; Public Agency Budgeting and Accounting; Public labor Relations
Consultant Firm Management	Northwestern and Georgia Tech have a full battery of Transportation Related courses, but they are costly to attend
Usually through the state centering around ITS, NT	ITS Professional Capacity Building courses.
The Traffic Engineering Institute via Northwestern	Northwestern Traffic courses, Georgia Tech courses, etc.
from ASCE other professional organizations	not sure
Traffic Operations Classes, Traffic Signal Optimizing	Traffic engineering related
not here, but courses available at Northwestern	Courses from the Northwestern University Center for Public Safety. Traffic Signal Control Workshop and many others.
Traffic & Transportation Engineering have a great	Courses at Michigan State Univ. and at Wayne State Univ.
Northwestern Transportation Institute, ITE, TRB	Transportation Planning/ Traffic Modeling
ITS (Berkeley) offers a range.	GIS users courses to stay up-to-date on the latest software
software-related (operating systems, etc.)	Berkeley has short courses. Also Northwestern? uni
MS in Infrastructure Engineering through U of Minn	All kinds from TEEX, ITE, ASCE, Univ. Neb., Geo. Tech., Northwestern, Univ. Florida, and others
transportation engineering, HCM, Land Development	organizational Design and Development, Management

	Development
several cont ed courses at different universities	CAD
Engineering and transportation related courses	ISU CE Cont Ed program, FHWA NHI courses, Auburn U CE Cont Ed program, TRB seminars, etc.
electronics, computers, power point	Various management, computer, and technical related training is available through out community college.
Technical Update forum Automotive Manufactures	Curriculum Development, ISO9001 Training, Leadership Development
Very general traffic courses - Transpeed here in W	Physical Therapy related courses are provided within the state for continued licensure
Delivery of distance education courses, technology	Education, teaching, subject matter content
Auto skills courses from Gateway Community College	As business technology educator, continuing education courses are offered in many areas within my field.
transportation technical training, ADA accessibility	TRAFFIC MANAGEMENT
Transportation Engineering	a variety of legal CLEs
Local university has traffic engineering courses;	from the Education Service Center Region XII-Waco in-service training
1000s	teaching strategies, legal aspects, specific occupational competencies
Many	FSUTMS courses by FDOT, other modeling/forecasting/planning courses around the country, seminars, etc.
Traffic Engineering-related courses	Northwestern University Center for Public Safety Courses, graduate work in transportation engineering
CAD training, roadway design, traffic design and p	Transportation Related training courses are offered by our Training Division regularly. From design to computer applications
Technical education teaching methods courses; comp	Numerous out of state short courses are offered
Northwestern's Transportation Engineering Courses,	Numerous Automotive Service Ind. Technical Update/
There are many. Some of the short courses	Transportation training thru TXDOT
Wetland courses, Hazwopper, NEPA process	teaching methods
Northwestern University	Traffic Flow theory
Northwestern traffic Institute has excellent program	Some transportation courses (technologist level)
Geopak Training, Computer Science courses	TEEX Engineering Training Course
UTA offers some courses in transportation and civil	only at dist level workshops & pro organ offer workshops
Human Factors, Training development, distance learning	Any courses pertaining to traffic operations/transportation
Traffic Calming, Highway Capacity, Project Management	Too numerous to list
Traffic Engineering related courses	ITE Seminars

Q7:

Responses	Total	Percent
Traffic Engineering	148	71%
ITS	113	54%
Systems Engineering	66	32%
Modeling/Simulation Software	122	58%
Analysis Software	98	47%
Telecommunications	68	33%
Systems Architecture	47	22%
Environmental Management	41	20%
Incident Management	52	25%
Emergency Management	31	15%
Financial Management	42	20%
Contract Management	56	27%
Grants Management	35	17%
Strategic Planning	75	36%
Other	42	29%

Q7a:

Wow! Courses on the role of PEOPLE in the transportation system. This is a HUGE need!	Indiv-directed efficiency increase courses: time, contact, proj. management courses
Use of Internet, communications skills	Hydrology and Hydraulics
Understanding data (Not just analytic software)	Human Factors in Transportation
Transit routing and ops, School Transportation Routing and Ops	Human Factors Engineering
Transit Planning	GIS in Transportation
Technician level Sign Management, maintenance, placement, markings placement, signal construction, street light and high mast operation maintenance.	geometric design, public speaking for hostile audiences
Technical classes in roadway design, structural design, etc.; of particular interest might be classes introducing new technologies and new methods.	Accident Reconstruction, Maintenance & Inspection of ITS and Electrical Equipment, Inspection of Pavement Markings
Sustainable Transportation Alternatives	disability accommodation
Supervisory Skills, Customer Relations, Safety, ADA	DEVELOPMENT PLANNING, ADA
Statistical methods in traffic engineering or transportation planning	Communication, Public Relations Skills, Public Speaking
simulation software system architecture	collision investigation
Instrumentation, Project management, Risk Management	Civil Rights Program Management; Diversity; Accessibility Planning; Environmental Justice;
safety, human factors	Auto Ind. Tech Update
Roadway Design, Hydraulics/Hydrology, SWPPP,	Air Quality Issues and EIS preparation
Roadway design	education (teacher in public HS)
Project Management	Accident investigation
Presentations and Technical writing	NEPA training
Safety; intermodal transportation; public involvement	Pavement preventive maintenance
New transportation technologies	

Q8:

Responses	Number	Percentage (%)
Very Important	34	16
Somewhat Important	123	59
Not Important	52	25

Q9:

Responses	Number	Percentage (%)
Yes	183	88
No	26	12

Q10:

Responses	Number	Percentage (%)
Yes	74	35
No	135	65

Q10a:

Responses	Number	Percentage (%)
Less than 25%	201	97
25 – 50%	5	2
50 – 75%	3	1
More than 75%	0	0

Q11:

Ranking	Interactive Video	On-line Courses	CD-ROM Courses
1 (favorite)	20	39	20
2	51	63	68
3	56	39	46
4 (least favorite)	27	14	24
0 (Not Sure)	54	53	50

Q12:

Responses	Number	Percentage (%)
once	83	40
twice	73	35
three	23	11
four-six	11	5
six+	5	2
Never	14	7

Q13:

Responses	Number	Percentage (%)
Yes	196	94
No	13	6

Q14:

Responses	Number	Percentage (%)
Yes	32	15
No	177	85

Q15:

Responses	Number	Percentage (%)
Yes	88	42
No	121	58

Q16:

Length of Course (CEUs)	$200	$300	$400	$500	$600	$700	$800	$900	Not Sure
1 day (0.8 CEUs)	102	24	1						82
2 day (1.6 CEUs)		71	50	4					84
3 day (2.4 CEUs)			10	15	4				23
4 day (3.2 CEUs)				45	44	16			104
5 day (4.0 CEUs)						55	33	14	98

Q17:

Responses	Number	Percentage (%)
High School	1	1
Associate Degree/Technical (Vocational) Education	6	3
Bachelor's Degree	63	30
Master's Degree	107	51
Doctoral Degree	32	15
Other / Decline to answer	0	0

Q18:

Responses	Number	Percentage (%)
Full-time	202	97
Part-time	3	1
Student	2	1
Retired	2	1
Other / Decline to answer	0	0

Q19:

Responses	Number	Percentage (%)
Less than 5 years	46	22
5-10 years	42	20
10-15 years	34	16
15-20 years	29	14
More than 20 years	58	28

Q20:

Responses	Number	Percentage (%)
Consultant	61	29
Educational Institution	41	20
Municipal Department of Transportation	29	13
State Department of Transportation	23	11
County Department of Transportation	10	5
Research Establishment	10	5
Metropolitan Planning Organization	9	4
Federal Agency	6	4
Systems Integrator	3	1
Automotive Manufacturer	3	1
Vendor	2	1
Public Transit Agency	2	1
Toll Road Authority	0	0
Law Enforcement	0	0
Other	10	5

Q20a: Other Responses - Province of Nova Scotia
Insurance
City Government
City department with emphasis on plan reviews
State economic development agency
Regional Transportation Agency
Land Association
Traffic Flagging & Certifying Flaggers at Community College
Teacher, but was in the Coast Guard for over 20 years

Q21:

Responses	Number	Percentage (%)
Alaska	1	1
Arizona	4	2
Arkansas	2	1
California	10	5
Colorado	5	2
Connecticut	1	1
Delaware	1	1
District of Columbia	4	2
Florida	7	3
Georgia	2	1
Hawaii	1	1
Illinois	4	2
Indiana	1	0
Iowa	2	1
Kansas	1	1
Kentucky	2	1
Louisiana	2	1
Maryland	3	1
Massachusetts	1	1
Michigan	8	4
Minnesota	7	3
Missouri	3	1
Montana	1	1
Nebraska	1	1
Nevada	5	2
New Jersey	1	1
New Mexico	4	2
New York	5	2
North Carolina	3	1
Ohio	1	1
Oklahoma	5	2
Oregon	4	2
Pennsylvania	4	2
Tennessee	3	1
Texas	56	27
Vermont	2	1
Virginia	13	6
Washington	11	5
West Virginia	1	1
Wisconsin	1	1
British Columbia	1	1
Ontario	1	1
Not applicable / No response	13	6

Q23:

Response	Number	Percentage (%)
Professional Engineer	101	48
Professional Traffic Operations Engineer	16	8
Project Manager Professional	6	3
Engineer In Training	26	12
None	53	25
Other	31	15

Q23a: Other Responses

Certified Planner	Certified Public Manger, American Academeny of CPM
Certified Engineering Technologist	PEng in Canada, EI in Colorado and New Mexico
school administrator; technical center director	C. Eng (UK)
ASE Master	LIcensed Psychol. PA; CFHP (Human Factors)
not transportation related	Professional Traffic Engineer
teaching	Teacher Certification
Technology Education	Associate Ergonomics Professional from BCPE
AICP	Vocational Education
FLAGGER,INSTRUCTOR, WORKSITE TRAF. SUP.WRD PROCESS	IMSA tech cert, CDL
Traffic Control Supervisor	ATSSA
Department of Education Manager's Certificate	Professional Traffic Engineer - California
Oklahoma Teacher Certificate, Vocatinal Business	American Institute of Certified Planners
English for scientific purposes & interested in HE	Licensed in physical therapist assisting
Training Generalist	Math Certification
teaching, administrative, vocational job placement	law degree
Certified Public Manager	Driver Ed teacher and Supervisor, Secondary Admin

Q24:

Responses	Number	Percentage (%)
Yes	209	100
No	0	0

Q25:

Responses	Number	Percentage (%)
Yes	207	99
No	2	1

Q25a:

Responses	Number	Percentage (%)
Dial-up Modem	19	9
ISDN	41	20
DSL	10	5
Cable Modem	5	2
Corporate LAN	102	50
Not Sure	27	13

Q26:

Responses	Number	Percentage (%)
Yes	199	95
No	10	5

Q27:

Responses	Number	Percentage (%)
PC	205	98
Mac	3	1
Other/Not Sure	1	1

Q28:

Responses	Number	Percentage (%)
Windows 95/98	105	50
Windows NT/2000	99	47
Apple Macintosh System 6 or higher	3	1
Sun Solaris	0	0
Linux	1	1
Other/Don't Know	1	1

Q29:

Responses	Number	Percentage (%)
Yes	191	91
No	18	9

Q30:

Responses	Number	Percentage (%)
Yes	183	95
No	9	5

Q30a:

Responses	Number	Percentage (%)
Dial-up Modem	148	77
ISDN	3	2
DSL	12	6
Cable Modem	16	8
Corporate LAN	0	0
Not Sure	2	1

Q31:

Responses	Number	Percentage (%)
Yes	186	97
No	5	3

Q32:

Responses	Number	Percentage (%)
PC	180	94
Mac	11	6
Other/Not Sure	0	0

Q33:

Responses	Number	Percentage (%)
Windows 95/98	161	84
Windows NT/2000	14	7
Apple Macintosh System 6 or higher	11	6
Sun Solaris	0	0
Linux	1	1
Other/Don't Know	2	1

AN ASSESSMENT OF OPTIONS FOR INTEGRATING TAXICABS INTO AN URBAN ENVIRONMENT

Ronald E. Goodwin

and

Dr. Carol A. Lewis

Research Report SWUTC/01/167902-1

Southwest Region University Transportation Center
Center for Transportation Training and Research
Texas Southern University
3100 Cleburne
Houston, Texas 77004

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16. Abstract

Discussions surrounding the inclusion of taxicabs into the planning processes in urban areas have been ongoing since the oil crises of the 1970s. While there are some commonalties in the regulatory guidelines concerning taxicabs, most of the regulations vary from city to city. Such guidelines protect the public's safety and provide some consistency among the city's taxicab providers. In areas without public transit, taxicabs may be the only form of public transit available. The challenges facing many planners and public officials where there is a mix of public transit and taxicabs is the seamless integration of all available systems of transportation. When this integration is successful it creates a transportation network that reduces congestion and pollution, and ultimately improves regional mobility.

This study examines the many ways taxicabs function in urban environments. The influences of the federal government and metropolitan planning organizations are critical for taxicabs to be successfully integrated into the urban transportation network. There are examples of taxicabs being subsidized by local governmental entities, and examples of unsubsidized situations. The principal focus will be to identify strategies for the inclusion of taxicabs in an urban environment. The city of Houston will serve as the specific model for local inclusion.

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ABSTRACT

Discussions surrounding the inclusion of taxicabs into the planning processes in urban areas have been ongoing since the oil crises of the 1970s. While there are some commonalties in the regulatory guidelines concerning taxicabs, most of the regulations vary from city to city. Such guidelines protect the public's safety and provide some consistency among the city's taxicab providers. In areas without public transit, taxicabs may be the only form of public transit available. The challenges facing many planners and public officials where there is a mix of public transit and taxicabs is the seamless integration of all available systems of transportation. When this integration is successful it creates a transportation network that reduces congestion and pollution, and ultimately improves regional mobility.

The presence of taxicabs in cities varies widely depending on several variables. Such variables include pedestrian facilities, favorable local legislation, and the public's perception of the taxicab industry. In many northern cities, taxicabs are a viable transportation alternative to the private auto. As such, taxicabs increase mobility options for those making specific trips where public transit may be too slow or not provide "door to door" service. In Houston, the taxicab industry languishes in the shadows of one of the country's most efficient all-bus transit systems. Additional local regulations restrict taxicabs to primarily serving destinations as the major airports, hotels, and shopping malls.

While there has been limited resurgence of taxicabs functioning as jitneys in some urban areas, the success of this service type has been limited to specific niche markets. These niche markets include rural areas, dense ethnic communities, and specific welfare to work programs. Officials recognize the importance of transportation in a successful transition from welfare to work. Many realize that traditional public transit may not completely provide the services needed. Therefore, the inclusion of all available forms of transportation, including taxicabs, becomes vital to provide the needed transportation services for all potential users.

This study examines the many ways taxicabs function in urban environments. The influences of the federal government and metropolitan planning organizations are critical for taxicabs to be successfully integrated into the urban transportation network. There are examples of taxicabs being subsidized by local governmental entities, and examples of unsubsidized situations. The principal focus will be to identify strategies for the inclusion of taxicabs in an urban environment. The city of Houston will serve as the specific model for local inclusion.

EXECUTIVE SUMMARY

This study examined the various strategies for the successful integration of taxicabs into an urban transportation network. The strategies include subsidized taxis (paratransit and jitneys), and unsubsidized transportation systems. Within the unsubsidized strategies taxicabs operate in a free market environment as any other business concern would with financial assistance from a governmental entity. This study also reviewed examples of taxicab systems in cities of with populations of less than 100,000 (small urban), 100,000 to 500,000 (medium urban), and more than 1 million (large urban).

The volume of literature about taxicabs and their potential urban uses reached a peak during the oil crises of the 1970s. However, urban planners and local officials in the last few decades have seemingly ignored the potential of taxicabs in reducing congestion and pollution. The resumption of new roadway projects imply that the new generation of engineers and planners have forgotten the gas-lines of the 1970s without an adequate contingency plan in the event of a massive shortage of fuel worldwide. In recent years different forms of rail systems attracted attention as a viable alternative to the auto in urban settings. However, the controversy surrounding urban rail may prevent its full potential from being realized. Still, even with the sparse literature discussing taxis and their use, the following is a summary of the available findings:

- Communities where inclusion of taxicabs occurred experienced improved local mobility;
- In the medium-sized urban areas, jitney-type services improved public transit coverage and service hours at a lower cost than would have ordinarily been possible;
- In the large urban areas, transit ridership increased through suburban feeder services and improved central business district (CBD) circulation. This resulted in a reduction of traffic congestion and air pollution;
- Transit patron's waiting tolerance for the next bus was about ten minutes;
- Integrated taxi services functioned well in areas with low-demand densities. Taxis provide transportation to smaller groups of individuals with better fuel efficiency than buses and will not contribute the same levels of pollution and congestion on local streets;
- Taxis provided services that were specifically designed to meet the special mobility needs of the elderly, handicapped, and low-income populations;
- Taxis supplemented public transit in the following ways: 1) providing extra peak-period capacity, 2) taking over services along transit routes at low demand times, and 3) extending services beyond the physical limits of existing routes;
- Taxis increased ridership to existing transit routes through feeder services from suburban communities to transit facilities (park & ride or transfer stations); and
- Taxis improved the mobility in CBD areas by functioning as a circulator system during morning, lunch, and evening peak hours.

Houston is a diverse community whose suburban development is consistent with other sunbelt cities. Since its inception in 1978, the Metropolitan Transit Authority of Harris County (Houston METRO) has provided public transit services through an all bus fleet. In 1998, Houston METRO operated 934 vehicles and purchased the transportation

services of another 569 vehicles (440 were demand responsive services and 129 were local bus services). Houston METRO's service area is about 1,200 square miles with annual revenue miles exceeding 48 million.

Given the previous general applications of taxicabs in urban areas, either subsidized or unsubsidized, this study specifically used Houston as a case study and identified the following strategies and their likelihood of success in such an urban setting:

1. Feeder and circulator strategies as *subsidized taxicab services* may find support in Houston. Feeder routes could serve communities outside the Houston METRO service area linking with existing transit facilities. This would provide seamless, coordinated transportation service with the many park & ride facilities and express bus routes currently operating throughout the region. Studies show that taxicabs operating along semi-fixed routes as a feeder or circulator can actually increase transit ridership in existing local services;
2. Taxicabs operating solely as a circulator system do not appear to be a viable option in Houston. Houston METRO currently operates an extensive network of trolleys in Houston's CBD and mid-town areas. CBD employees and visitors can park their cars at outlying parking lots and maneuver throughout the trolley service area very efficiently without more than an 8-10 minute delay. The addition of a network of circulator taxis would increase CBD congestion during morning and afternoon peak hours, while not providing any substantial gains in mobility;
3. The potential for an *organized free market option* appeared more promising than either the feeder or circulator subsidized system. This involves the establishment of a "taxi zone" by the city of Houston supporting increased taxicab activity in a specific area. Such a zone would have a base fare structure for trips originating and ending in the zone. For travel outside that zone, a different, consistent fare structure would apply. Local ordinances allowing shared rides would need to be examined to determine if such an arrangement would increase mobility. The support needed for the implementation of a taxi zone would come from local governmental entities and business organizations like the Greater Houston Partnership, transportation management organizations, and area civic groups.
4. The current *paratransit system* between Houston METRO and local taxicabs appears to be the most successful current use. This arrangement allows for the reimbursement of trips made by taxicabs on behalf of Houston METRO. This arrangement increases urban mobility to a particular segment of the population that is the most transit dependent. The individual taxicab owner operators still have the opportunity to provide other voucher services and free market trips.

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INTRODUCTION

There have been several industrial developments that shaped the lives of every person in our nation's cities. The widespread use and availability of the telephone drastically improved personal communications. The development of the television introduced a new industry while bringing entertainment directly into the home. The end of the 20th century witnessed the explosion of the personal computer and its sidekick the Internet. Many analysts predict computers will eventually replace the telephone as the primary means of mass communications, and replace the television as the method of personal entertainment.

Perhaps the most significant urban development of this century is the automobile. Initially viewed as a toy for the rich and famous, Ford's development of the assembly line in the 1920s made the auto affordable to the working class. Practically overnight the auto improved urban mobility and closed the spatial gap between urban and rural communities. Since the 1920s many urbanists and sociologists documented the history of the auto and it's the social and economic effects on the city. The one aspect of the auto's history that receives sporadic attention is that of the taxicab industry. The near extinction of public transit in the 1960s and 1970s renewed interest in all forms of urban transportation. Since then urban officials have flirted with the idea of including the taxicab into the urban transportation network where no public transit exists or as an augmentation to established public transit services. Some metropolitan areas established pilot projects involving taxicabs and/or jitneys with varying degrees of success.

Community and transportation officials recognized decades ago that urban sprawl and low density residential development would have disastrous effects upon urban environments. Urban sprawl has also negatively impacted the services provided by public transit. In the 1970s public transit faced challenges of providing services in urban areas and in many small cities where the travel demand was too small to even support an efficient transit service at all. It became economically unfeasible to route and schedule bus transit services where there was little demand. Rail systems were too expensive and technologically unsuited for low volumes of demand. Bus services in low demand areas invariably only served those who were transit dependent. Public transit needed a means to respond to the needs of low-density developments economically and efficiently. This led to the introduction of flexible bus systems or dial-a-rides.

Initially, dial-a-ride systems using buses were seen as the answer in providing flexible urban transportation. However, it becomes clear that when examining institutional and operational difficulties those buses were not efficient in a flexible system. Officials then turned to taxicabs and found that they are better suited to respond to low density travel in urban environments.

Currently, taxicabs are a fixture in many paratransit systems across the country. Paratransit services are either provided by a local social service entity or the area transit authority. There is seldom any coordination between social service transportation providers and transit authorities on the best way to utilize taxicabs. The taxicab can be a

viable addition to the urban transportation network. However, planners and officials at all levels must show a commitment to their inclusion and should consider the following:

Federal initiatives like ISTEA, and its successor TEA-21, recognized that neighborhood and community public transportation services have been largely neglected in urban transportation planning. Traditional planning processes focused on major capital improvements such as building or redesigning roads and highways. ISTEA and TEA-21 support the use of transportation systems management to place greater emphasis on the efficient use of existing resources to enhance urban mobility.

Taxicabs should be a complement to mass transit, not a competitor. Traditionally urban transportation planners viewed the mass transit vehicle operating over a fixed route and fixed schedule as the only public transportation solution to all public transportation problems. However, it is now clear that taxicabs can and should be used as a complement to mass transit service. In many cities taxicabs provide elderly and handicapped transportation services, serve as a feeder system for regular transit routes. In Houston, taxicabs expanded existing transportation services during the oil embargoes of the 1970s. These are just a few of the examples that illustrate the potential uses of urban taxicabs.

SUMMARY OF LITERATURE

The literature governing taxicabs and urban mobility reached a peak in the 1970s. Urban planners and local officials in the last few decades seemingly ignored the potential of taxicabs and focused on establishing commuter/light rail and high occupancy lanes (HOVs)

The following are some of the findings from the existing literature:

- Communities where inclusion of taxicabs occurred found they benefited by the improvement in local mobility.
- In the small urban area, mobility increased for those without access to cars.
- In the medium-sized urban area, jitneys improved public transit coverage and service hours at lower cost than would have been possible with public transit techniques alone.
- In the large urban area, transit ridership increased through suburban feeder services and improved CBD circulation. This resulted in a reduction in traffic congestion and air pollution. In addition, the transit authority has been able to transfer some of the extreme peak demand for transit to jitneys and make more efficient all-day use of a smaller number of vehicles and drivers.
- A ten-minute wait for a transit vehicle appears to be the riders' limit of tolerance.
- Integrated taxicab services function well where there is low-demand densities and can efficiently transport a few riders at a time without high consumption of automotive fuels and without aggravating existing traffic congestion and air pollution.
- Provide the sole means of public transportation in small urban areas.

- Provide services that meet the special needs of the elderly, the handicapped and low-income residents of a given region.
- Supplement public transit by 1) providing extra peak-period capacity, 2) taking over services along transit routes at low-demand times, and 3) extending services beyond the limits of existing transit routes.
- Increase ridership of existing transit systems through feeder services from suburban communities to transit facilities (transfers station or park & ride lots)
- Provide limited mobility in high dense CBD areas through a circulator system.

METROPOLITAN PLANNING ORGANIZATIONS

Perhaps the most important function that a Metropolitan Planning Organization (MPO) or other urban transportation planning agency can undertake with regard to taxicabs is to provide a venue for coordination. An important part of cooperative transportation planning is the existence of mutual confidence and respect among the organizations involved. In the case of taxicab planning, the establishment of good relations between the taxicab industry, public transit agencies, local governments, and the general public is imperative for any kind of successful taxicab integration.

The first aspect of coordination involves an understanding of the entities to be coordinated. Transportation planners must inform themselves of the local taxicab industry, regulations, pertinent issues, and vehicle inventories. Another task in this regard is keeping abreast of what other urban areas are doing, what the status is of policies regarding federal grants and taxicabs, and what the findings are in the various ongoing taxicab demonstration projects. This is particularly important since it appears that many innovations in demand-responsive transportation yield unexpected results, both positive and negative.

Through TEA-21 the MPO is in a position to begin the incorporation of taxicabs into the regular transportation planning process almost immediately. Section 1203 (f) (C) allows MPOs to include accessibility and mobility options within their scope of planning processes. Additionally, TEA-21 provides several funding mechanisms for increased urban mobility. Among these are the FTA's metropolitan planning authorizations of

$73.6 million per year for the six years of TEA-21. This is a total in excess of $441 million that is available to MPOs for urban mobility programs.

Since there are few barriers to immediate taxicab inclusions, the community will see federal dollars at work instantly. Unlike freeways and transit guideways that generally require elaborate capital financing programs and a construction period of several years, changes in the taxicab systems can take place relatively quickly with little or no capital investment. The high flexibility and low capital nature of the taxicab industry is perfectly suited for short-range, policy-oriented planning. However, this should not exclude taxicabs from being a significant part of the long range planning processes. Future issues concerning local regulations, federal subsidization, and suburban mobility are issues the MPO will need to address.

FEDERAL GOVERNMENT

There have been several studies examining the role of the federal government in this nation's public transit services. That role has traditionally been financial in the form of subsidies and funds for capital improvement projects. However, the federal government does provide grants to social service entities to support local/regional paratransit services.

The Department of Transportation (DOT) initiated several programs to aid states and MPOs in addressing local transportation needs. Strategies to include taxicabs in the urban network can be funded through these programs. The following are a few of the DOT programs available to MPOs.

Urbanized Area Formula Grants Program

The Urbanized Area Formula Grant Programs are sponsored by the DOT and FTA and provides funding for transit capital projects and assistance for some operating expenses. The urban area must have a population in excess of 50,000 as the funds are apportioned using a formula based on the following: population, population density, existing transit service, and transit ridership. All publicly and privately owned transportation agencies are eligible to apply. Taxicabs benefit from this program as qualified projects include those that help communities reduce traffic congestion. In terms of available funding, in fiscal year 1999 the DOT set aside $2.5 billion and proposed $2.9 billion for fiscal year 2000.

Livable Communities

The DOT and FTA are the sponsoring agencies for this initiative. This program helps communities get involved in planning and designing transit systems that are customer-friendly, community-oriented and well designed. Those eligible to receive funds under this program include transit operators, MPOs, city and county government, planning agencies. Any other public bodies with the authority to plan and/or construct transit services are also eligible to apply. Non profit organizations are not allowed to apply directly for assistance, but may participate as partners with one or two of the eligible entities. The DOT and FTA provide a list of eligible projects and they include:

- Planning pedestrian walkways and transit-oriented development;
- Assessing environmental, social, economic, land use and urban design impacts of projects;
- Studying the feasibility of transit projects;
- Providing technical assistance;
- Funding participation by community organizations and the business community, including small and minority-owned businesses and persons with disabilities; and
- Evaluating best practices and developing innovative urban design, land use, and zoning practices.

Job Access and Reverse Commute Program

The Job Access and Reverse Commute Program provides funding for the development of new or expanded transportation services that connect welfare recipients and other low-income persons to jobs throughout a given area. Those eligible to apply for funds under

this program are state and local governments, MPOs, public transit agencies, tribal organizations, and non-profit organizations. The sponsoring agencies fund projects such as shuttles, vanpools, and guaranteed ride home programs. Reverse commute projects are limited to those that provide transportation services to and from suburban employment centers.

Surface Transportation Program (STP)

The DOT and Federal Highway Administration (FHWA) are the sponsoring agencies for this program. The STP is a flexible funding mechanism that state and local governments can use on any federal-aid highway, including the National Highway System, bridge projects on any public road, transit capital projects, and public bus terminals and facilities. A portion of funds reserved for rural areas may be spent on rural minor collectors. Local entities can apply for this program only through their state DOTs. This program is limited to state transportation agencies only. A total of $33.3 billion is available for the fiscal years 1999 to 2003.

Congestion Mitigation and Air Quality Improvement Program (CMAQ)

This program funds projects in areas that do not meet the National Ambient Air Quality Standards (non-attainment areas) and former non-attainment areas that are now in compliance (maintenance areas) for ozone, carbon monoxide, and small particulate matter. Funding helps these areas meet the requirements of the Clean Air Act. The DOT and FHWA sponsor this program and limit eligibility to state DOTs and MPOs. Eligible projects include those that will reduce transportation-related emissions, such as transit

improvements, travel demand management strategies, traffic flow improvements, and public fleet conversions to cleaner fuels. Funding is available to those areas based on a formula that considers population by county and the severity of air quality problems.

INTEGRATED TAXICAB OPTIONS

The literature concerning taxicabs since the late 1960s discuss two primary options for the integration of taxicabs in urban areas, either as subsidized or unsubsidized (free market) systems. Subsidized strategies include taxicabs operating in paratransit systems or functioning as a jitney. The subsidies can come from a variety of sources such as the local transit agencies, local government (city or county), or the area MPO. While the free market option relies solely upon the ability of the taxicab operations to provide an attractive transportation alternative, they still require favorable local ordinances and clearly defined guidelines to protect themselves and the consumers. The following examples detail the experiences of subsidized and unsubsidized taxicabs in an urban environment of varying sizes.

Paratransit Systems

There are many examples of paratransit systems nationwide. The following example shows the establishment of paratransit services in a single county in California and is fairly representative of the examples found throughout the paratransit literature. Even though these examples are from the late 1970s, they illustrate how important commitment and cooperation are to the successful initiation of taxicabs as a paratransit service.

In Chico, California, the city council received pressure from local groups to establish some form of public transit system. Believing there was not enough potential ridership for a traditional transit service, the city council began examining paratransit-type services. Even though funds were available for a paratransit system, every dollar used for public transit meant less money would be available for the construction or repair of area

streets and highways. At this time surface transportation projects, streets and highways, were the highest transportation priority of local officials. Accordingly, the planning staff at the county and state levels found themselves under pressure to develop the most cost-effective service possible.

The two most important aspects of system organization were shared ride operations and compensation of the paratransit provider on a consumed service basis. The compensation aspect was accomplished by paying the provider a fixed fee per ticket collected from the riders. The ticket system also made it easy to limit eligibility to the elderly and handicapped and eliminated the problem of the operator handling (and possibly mishandling) cash. It was also decided that the provider should supply the vehicles for the system, at least initially, which would allow the services to begin immediately.

These principle features of the system's organization, shared ride and available vehicles clearly were most compatible with the operation of a local taxi company. Not surprisingly, a local taxi company submitted the winning bid. The operator agreed to $1.95 per ticket collected and up to three individuals could ride on one ticket.

Soon after the service began it became evident that the paratransit service would be successful. Ridership increased steadily, patrons were satisfied with the level of service, and costs were reasonable due to the use of the fixed fee per ticket scheme. Accordingly, other cities in Butte County, none of whom had any public transit service at this time, also became interested in local paratransit services.

The opportunity to become a publicly subsidized paratransit contractor was quite welcome for the contractor in the cities of Chico and Paradise. The contractor's ambulance and taxi businesses were not particularly profitable. Within a few months of starting paratransit service the contractor sold the taxi company, recognizing that there was much more money in transit contract operations than in regular taxi service. The initiation of the subsidized elderly and handicapped services severely reduced the city's already meager taxi market.

The poor economic prospects of taxi service in Chico resulted in the taxi service being sold and purchased several times. Demand became so low that operating a profitable taxicab business seemed impossible. The existence of the taxicab service in Chico became important to the paratransit service provider and City leaders since taxicabs operated 24 hours a day and the paratransit service only operated 10 hours a day.

The City of Paradise, also in Butte County, prodded by its senior citizen community, was the next to take the plunge into elderly and handicapped transportation services. In mid-1977 the County solicited bids on the Paradise paratransit system. In contrast to the Chico situation, however, the Paradise Taxi Company did not want to bid on the service. The owner decided it was in their best interest to avoid all partnership agreements with all levels of government or a subsidized service. Additionally, the owner openly opposed any and all attempts to initiate any form of public transit in Paradise. Once it became clear that the local taxis would not participate in the system, the paratransit provider from

Chico expressed his desire to duplicate the service in Paradise. Within a few months the City awarded him a second paratransit contract.

The City of Oroville was also interested in public transit; however, they were the most hesitant of the three cities to start a new service. The poorest of the three communities and the home of most of the county's lower income residents, Oroville was concerned that it might become involved in a service that turned out not to be cost-effective and then be unable to extricate itself. The director of the CALTRANS office, who was an advocate of public transit for the Butte County cities, came up with a solution. Butte County and the City of Oroville agreed to apply for a state grant for a transit demonstration project.

The grant program was administered by CALTRANS, so obtaining approval was not difficult given the strong support of the local CALTRANS office. The advantage to Oroville was two-fold. First, the grant period was for at most a year, thus giving the City an easy way to drop the paratransit service if it proved too costly or otherwise unsuccessful. Second, during the grant period the state paid most of the cost of the program, allowing the City to experiment with only a small amount of available funds. The Oroville City Council accepted the merits of a paratransit service designed primarily for the elderly and handicapped on this basis.

Because of the taxi involvement in Chico and Paradise, there was a strong presumption that the local taxi company would be the contractor, and local officials even invited its management to accompany them on a trip to Southern California to investigate several

similarly designed paratransit systems. While there was a formal award process for the contract, the organizational parameters--consumed service compensation and the use of the provider's own vehicles, in particular--all but preordained the choice. As the Yellow Cab Company was the only taxi company operating in Oroville, the City selected the company as the provider with a bid of $1.75 per ticket.

The owner of the Yellow Cab also owns Oroville's only transit company, Oroville Bus Lines. This bus service only operates on a contract basis, providing transportation services for the handicapped school children of Butte County, fire fighters, and a limited local fixed route service.

In order to reduce expenses, the paratransit services and the unsubsidized Yellow Cab taxi operations share management, employees, and facilities. By keeping regular taxi fares low, and streamlining the management of personnel and equipment resources, the contractor is able to realize operation efficiency in both operations. Some of this operational efficiency stems from using family members as management and office staff, which means that people do the work with a direct economic stake in the well being of the company.

The taxi drivers are also pressed to be as efficient as possible, in particular to deliver speedy service. This has led to complaints from some of the users of the elderly and handicapped services, who expect more personalized service. The contractor resisted these demands, and insisted that his drivers be compensated by patrons for such services

as carrying grocery bags to the door. In his view, highly responsive service--which means low wait and ride times--is the real measure of level of service to the user.

Jitneys

Extended forms of taxi/jitney service cover a spectrum of public transportation alternatives that range from traditional individualized taxi service to fixed route type service. Jitneys characteristically provide specialized transportation services for small groups of riders. Its great advantage over public transit in this regard is that the services can be designed to meet the specific needs of these groups. Services can be designed to serve selected socio-economic groups such as residents of a low-income neighborhood, or provide a specific type of service to a broader group of users, such as feeder service to mass transit systems.

Jitneys typically operate along fixed routes stopping to pick up and drop off passengers only upon request. Jitneys may stop in the middle of a block in answer to a hail, but more regularly they take on and let off riders at designated curb zones near intersections. In order to operate profitably, jitney operators usually limit service to high density travel corridors, although it is possible for them to provide fixed-route service to a major facility, such as a shopping center, at some distance from the nearest residential or commercial area.

In addition to paratransit services already discussed, taxicabs as jitneys also provide an inexpensive alternative to public transit, in some rural areas, or the use of private vehicles

in five important market areas. Jitneys can provide the sole means of public transportation in rural and some small urban areas when population size and density are not sufficient to support traditional public transit. Jitneys can operate more economically than buses at low-demand commuting times, such as the evening hours, as their capacity is ideal for small passenger loads. Continuation of service over these periods is of special benefit to those in the community who rely entirely on public transit, and the transit authority may choose to contract for the jitney operation as an alternative to serving the routes with buses.

Jitney services are capable of performing an essential role in promoting overall ridership of an integrated transit system. Jitneys are especially suited to providing feeder services to regional rail transit and express bus systems, and can relieve some of the peak-period demands on transit facilities along major travel corridors. However, studies show that jitney services designed to compete with existing public transit services can attract riders from line-haul routes. This is especially true in lower density areas where existing mass transit service is already poor.

Still, when routed along parallel streets during the peak hours, jitneys serve not only to improve access to public transportation, but also would reduce the number of transit vehicles and personnel required to meet the intense demands of these short periods. The economies derived from more extensive utilization of a smaller fleet might be such that the transit authority could subsidize the peak-period operation of jitneys for commuter transportation.

Another important feature of jitney services is that several different services, each designed to serve a particular market, can be offered simultaneously by a taxi company within a single integrated operation. In fact, a well-planned, multi-faceted system offers the best potential for optimum utilization of labor force and equipment. One type of service may be directed toward commuters, with a complementary service making use of the same resources during off-peak hours.

The use of readily available passenger cars and vans, which permits immediate implementation of new systems at relatively low capital investment is one of the attractive characteristics of jitney services. Even though some form of dispatching system is essential to the operation of the demand-responsive types of jitney services, the taxicab company, where economically feasible, should use its existing capability to serve both the original taxi operation and new jitney services. However, since most jitneys operate on fixed route services, they have no need for the complex dispatching systems of taxi operations.

Riders of jitneys are not easily categorized. In Latin American countries, the jitney is a familiar and more comfortable mode of travel than public transit. While in Atlantic City ridership is largely made up of tourists who find they can travel more easily by jitney than with their own cars because of the shortage of convenient parking spaces. Another large segment of Atlantic City users is made up of school children, which can purchase books of reduced-fare tickets at their schools.

Taxis and jitneys are commonly regulated at the local level, and most existing city ordinances prohibit both shared-use of taxi vehicles and all jitney operations. The private operator will need to determine what the local regulations are in each specific area.

The literature indicates that taxicabs operating along semi-fixed routes have definite applicability in a wide range of urban settings. The following is an example of findings from such services in cities of varying sizes, illustrating how coordination and commitment at all levels can enhance mobility in conjunction with existing public transit. In some small urban or rural communities there are strategies that will allow these services to operate as the sole means of public transportation.

FREE MARKET SYSTEM

In a free market environment individual taxicabs compete with one another for riders. Local governing bodies do not subsidize any portion of the potential trip, or limit the number of taxicabs serving a particular area. However, local ordinances allow for shared-ride taxi services, as long as all of the passengers give their consent. Furthermore, regulations should provide guidance on various service-related issues such as 1) maximum number of hours a taxicab driver can work, 2) the number of operational hours, of days per week, of taxicab vehicles and 3) the type of taxicab operation (fleet, lease, or owner operated).

Local jurisdictions regulate the fare structure for taxicab operations. The basis for most fare structure are the metered systems or the zone fare system. With the metered system the fares include an initial fee for the first increment of distance traveled and additional fees for each extra mile. In the fare zone system, there is a clearly defined service area with specific charges for trips that originate and end within one zone, or between two zones.

In the early 1980s the New York City Planning Department studied the urban effects of express and local feeder for-hire taxis on local mobility (many of these taxis used 12-15 passenger vans). Additionally, they wanted to determine the operational, legal, and economic effects and establish City policy that would maximize the benefits while simultaneously decreasing the negative effects. It was assumed that competition between

the taxicabs and subsidized transit through normal market responses would improve mobility throughout the city. There was also the assumption that an efficient free market transportation alternative would reduce the need for expensive subsidized transit.

The study identified two types of van services being offered. The first was an express service into and out of the Manhattan CBD. The other was a feeder service to outlying New York City Transit Authority (NYCTA) transit stations. Both services were most widely used during the morning peak hours. The study estimated the total combined daily ridership to be somewhere near 10,000 passengers to and from Manhattan. Another 5,000 daily combined passengers were from the suburban areas.

Most of the express vans operated in direct competition to NYCTA express buses or the subway. Seventy-five percent of all van passengers began or ended their trip in Manhattan's four outer boroughs (Bronx, Brooklyn, Queens, or Staten Island). Only 16 percent of the riders were from Westchester and Upstate New York, seven percent from New Jersey, and only two percent from Connecticut. There were over 500 trips in the morning peak hour compared to just over 480 in the afternoon peak hours.

The local feeder service charged the same fare as the subsidized bus services, but provided services into areas where NYCTA did not have regular transit services. The feeder services linked high-density areas like Brighton Beach and Sheepshead Bay with the nearest NYCTA transit station. The study found that these van actually increased ridership at the NYCTA's transit stations.

The study found that the van systems, both the feeder and express routes, increased congestion in the corridors they operated in. The congestion in lower and midtown Manhattan became especially serious as van competed for the limited curb and street space. Many of the van operators illegally used bus lanes adding to the congestion of over 100 buses that legally operate in these designated lanes. Some vans load and unload passengers from the street side and prevent unhindered access to many of the City's bus stops. During the period of the study, the city estimated lost revenues to NYCTA to be in excess of $8.5 million annually.

The study also found that van operators sincerely believed that they provided needed transportation services. Most van passengers interviewed thought the vans were an improvement over the subsidized transit services (over 95 percent of those surveyed were former transit riders). NYCTA published its own report estimating that over $30-$50 million in lost revenues annually from the van services. Some city officials supported the van services as a mean to increased mobility in congested corridors. While other argue that the vans consume valuable street space. Enforcement of the city's licensing procedures was sporadic and ineffective.

The study's recommendations focused on licensing, enforcement, and street use guidelines. It was generally agreed that the taxi services provided needed increased urban mobility options, even though they reduced NYCTA's overall revenues because of the direct competition in certain corridors. Still, the proliferation of uncontrolled,

unlicensed and unregulated vans negatively affected transit operations and traffic congestion. Organized and controlled taxi services would complement existing subsidized transit services by increasing mobility in areas with poor accessibility and inadequate transit services.

It was unclear whether some, all, or none of the taxi services identified in the study operated along fixed, or semi fixed routes. It can be assumed from the very nature of feeder and local services that there was some type of fixed schedule, in terms of time and/or route. The taxi services exposed many of the deficiencies in NYCTA's transit services. These deficiencies were slow and/or overcrowded buses, limited subway coverage, and few mechanisms to ensure passenger safety.

Small Urban Area, Population less than 100,000

This is a community where residential densities are possibly too low to support traditional public transit. However, the taxicab businesses, with assistance from local governmental entities, can increase area mobility by initiating the following strategies:

- Establish a dial-a-ride and/or jitney service during the traditional work hours (7a to 6p) that is subsidized by local governmental entities.
- Encourage the existing taxicab businesses to increase its hours of operation to 24-hour service, seven days a week.
- Establish subscription commuter services for night-shift workers. This service should be free to the employees and subsidized by the employer.

Medium-Size Urban Area, Population between 100,000 and 500,000

In most medium sized urban areas some form of public transit exists, even if it is just a limited service. This will allow a taxicab company to supplement the existing transit services by considering the following strategies:

- Establish a jitney service as 1) an internal CBD circulator and 2) a feeder service to main line buses. The local government and/or the transit agency provide the subsidy.
- Use jitneys along bus routes during hours of low ridership. The transit authority subsidizes this service.
- Enhance current taxicab operations with the local government providing some form of subsidy for low-income residents. The subsidy could be in the form of reduced tickets sold through social service agencies.

Large Urban Area, Population greater than 1,000,000

In this urban setting there is an established central city typically with an extensive public transit network. Public transit resources usually include buses and in some communities some form of commuter rail. The literature illustrates that the integration of taxicabs in this setting requires the highest levels of cooperation. The following are strategies that would allow the inclusion of jitneys to supplement existing established transit services. Both options could be subsidized by the transit agency in coordination with local governments.

- Establish subscription taxicab, dial-a-ride, or jitney services for suburban communities to provide internal circulation and as a feeder service to express bus routes. The transit agency and local governments provide some form of subsidy.
- Establish jitney services along streets parallel to those used by buses to reduce traffic congestion during peak commuting hours.

TAXICABS OPTIONS IN HOUSTON

Houston is a diverse community whose suburban development is consistent with other sunbelt cities. The Metropolitan Transit Authority of Harris County (Houston METRO) provide public transit services through an all bus fleet since its inception in 1978. There have been discussion of including some form of a rail component since the early 1980s and recently Houston METRO identified one of the most congested inner city corridors for the first leg of a new modern light rail system.

Houston METRO serves an area of over 1200 square miles with annual passenger miles of over 533 million miles with annual revenue miles exceeding 48 million. In 1998, Houston METRO operated 934 vehicles in bus operations and purchased another 569 vehicles (440 in demand responsive services and 129 in bus services). Houston METRO does not operate any vehicles in a demand responsive capacity. The following tables illustrate Houston METRO's performance indicators as measured by the Federal Transit Administration's (FTA) 1998 National Transit Databases:

Table 1. Houston METRO's Performance Indicators

Performance Measures	Bus	Demand Responsive
Operating Expense/Vehicle Revenue Mile	$4.91	$1.55
Operating Expense/Vehicle Revenue Hour	$70.89	$32.29
Operating Expense/Passenger Mile	$0.37	$1.32
Operating Expense/Unlinked Passenger Mile	$2.04	$13.81
Unlinked Passenger Trips/Vehicle Revenue Mile	2.41	.11
Unlinked Passenger Trips/Vehicle revenue Hour	34.83	2.34

Source: Federal Transit Administration, 1998.

The Greater Houston Area Chapter of the American Red Cross provides non-emergency transportation services for individuals who have no other transportation options. The Red Cross also contracts transportation services for wide variety of health and human services agencies. Before 1993 the Red Cross' transportation services were strictly voluntary. The decision to expand the transportation service provided arose from the needs of Red Cross' client base. Up to 20 percent of the trips made by the Red Cross are through volunteers, the rest are financed through contracts or state/federal grants. These services are not designed to compete with existing Houston METRO local routes. The Red Cross' unofficial transportation philosophy is that "if someone can ride the bus, get on the bus."

The relationship between the local taxicab companies and the Red Cross arose out of the need for additional transportation vehicles. When the demand for transportation services exceeds the Red Cross' capabilities, they contact one of the taxicab companies they have contractual agreements with. The information for a particular trip is faxed to the taxicab

company and they dispatch one of their drivers to the location. The patron incurs no cost as the taxicab company forwards an invoice to the Red Cross on a periodic basis.

The major challenge to this arrangement involves the availability of taxicabs to respond to the Red Cross' request. There appears to be no real incentive for coordination on the part of the taxicab companies. Red Cross officials admit that many of their requests have not been answered by the taxicab companies in a timely manner.

Houston METRO also contracts with taxicab companies in providing paratransit services. Houston METRO provides its customers with vouchers to use with contracted taxicabs. Houston METRO pays the first $8 of any given trip, while anything over $9 is the responsibility of the customer. Taxicab officials generally like the voucher system and state that this is also beneficial to Houston METRO as their paratransit services generally cost about $35 per person while taxicabs provide incur only $18 dollars per person. This particular taxicab official has had a contract with Houston METRO since 1982 and typically provides 9,000 trips monthly under the voucher program.

General Applications

Given the previous general applications of taxicabs in urban areas, either subsidized or unsubsidized, the following discuss each application in Houston and its likelihood of success.

The feeder and circulator strategies are subsidized taxicab services that may find support in Houston. Houston METRO operates 41 transit facilities throughout its service area. Feeder routes could service communities outside the Houston METRO service area through the transit facilities, thus providing seamless coordinated transportation service with the many park & ride and express routes currently operating. Studies have shown that taxicabs operating along semi-fixed routes, similar to that of jitneys, can actually increase transit ridership in existing transit services.

Houston METRO sponsored a limited jitney project that lasted only two years. From this brief experience there were a few findings that indicate the future of semi-fixed routes, and the integration of taxicabs in a subsidized form. The jitney route operated along the one of the busiest corridors in Houston and in competition to the local route with the highest ridership. This jitney served primarily minority patrons and made connections to a park & ride facility. The failure of the jitney services may not have been due to a lack of ridership support, but the nature of the administrative structure. After extensive political maneuvering, the Houston City Council allowed jitneys to operate legally in Houston after almost 70 years. However, any jitney service had to be under the auspices of Houston METRO. Therefore, the subsidy to the jitney contractor came from Houston METRO, not the city of Houston or the Houston Galveston Area Council (HGAC), the local metropolitan planning organization (MPO). The fixed route service began under intense local media attention, and ended virtually unnoticed by the public.

Therefore, coordination is key for any type of subsidized feeder system to be successful. It is also critical that the feeder system(s) compliment rather than compete with Houston METRO's established routes. The taxicabs would be given specific times and zones of daily operations and area communities would further be able to personalize the taxicabs serves in their communities. The specific guidelines for the feeder services could be established by HGAC with input from its member communities.

The other subsidized option, a taxi circulator route, does not appear to be viable in Houston. Houston METRO operates an extensive network of trolleys in Houston's CBD and midtown areas. CBD employees and visitors can park their vehicles at distant facilities and maneuver around the trolley service area very efficiently without more than an 8-10 minutes delay. A network of circulator taxicabs would only increase congestion and not provide any substantial gains in urban mobility.

The potential for an organized free market option appears more promising than either the feeder or circulator subsidized systems. The establishment of a "taxi zone" by the city of Houston would foster increased taxicab activity in a specific area. Such a zone would have a base fare structure for trips originating and ending in the zone. For trips that would require travel outside of the zone, a different, consistent fare structure would apply. Local ordinances allowing shared rides would need to be examined to determine if such an arrangement would increase local mobility. The support for a "taxi zone" would need to come from local governmental entities and other business organizations

like the Greater Houston Partnership, transportation management organizations and possible area civic groups.

The current paratransit system between Houston METRO and the local taxicabs appears to be the most successful current use. This arrangement increases urban mobility to a particular segment of the population that is the most transit dependent. The effects of the taxicab companies are also minimal as the general operation is not consumed by contractual obligation to Houston METRO. The individual taxicab owner operators still have the opportunity to provide voucher services and free market trips.

CONCLUSIONS

City and transportation officials have sought to integrate taxicabs into an urban transportation network for decades. In many cities taxicabs augment existing public transit services with varying degrees of success. The guidelines that regulate urban taxicabs protect the public's safety while providing consistency among the many taxicab companies licensed to operate. In areas without public transit, those classified as rural or non-urban, taxicabs may be the only form of public transportation available. The challenge in the urban environments that have public transit services and taxicab companies is to seamlessly integrate all available systems of transportation into a viable network. The long-term objective would be the reduction of congestion and improved regional mobility.

The national resurgence of the jitney as a form of urban transportation in niche markets provides only limited opportunities for the taxicab industry. Such niche markets include rural residents, new immigrants in dense communities, and participants of local welfare to work programs may not be sufficient to justify the existence of a semi-fixed route transportation service. However, government officials recognize the importance of transportation to welfare recipients in accessing employment, and further acknowledge that public transit may not completely provide the needed services.

Most recently, in cities like Houston, taxicabs have had measurable successes in providing paratransit transportation. In this manner, they operate on an as-need basis with a customer base that schedules their use either hours or days in advance. As such,

their function would be similar to that of the "traditional" service offered by taxicabs, except for the advanced scheduling.

The coordination between Houston METRO and local taxicabs is one that needs further evaluation. However, given the longevity of the relationship, it seems to be very successful. The elderly and handicapped are a special segment of the population whose transportation needs have recently received much needed attention. The Americans with Disabilities Act removed the physical barriers in accessing normal bus services. However, many individuals still cannot use those services some a variety of physical reasons. As such Houston METRO's paratransit services will continue to play a major role in providing mobility. In 1998 Houston METRO purchased the transportation services of 440 vehicles from other transportation providers, including taxicabs. This is more cost effective than actually purchasing 440 vehicles for inclusion into Houston METRO's fleet of vehicles.

The use of taxicabs as a feeder system would only be successful if the surrounding communities would support it. Many of Houston METRO's numerous park & ride facilities extend to the outer limits of their service area and provide comfortable access to the CBD via express and commuter routes. There may not be a sufficient ridership demand for a subsidized fixed, or semi-fixed, route feeder service from non-urban communities to Houston METRO's transit facilities. A pilot program supported by HGAC would be the best way to determine if such a ridership demand does exist without a major monetary investment.

A subsidized taxicab circulator system does not appear feasible given Houston METRO's extensive network of trolleys in the CBD and midtown areas. The result would be increased congestion and direct competition with Houston METRO. One of the most important consideration in any integrated taxicab options that should be avoided is direct competition with existing public transit services.

The establishment of a "taxi zone" would encourage increased taxicab activity in a specific area like Houston's CBD and along dedicated congested corridors. Local ordinances inviting transit patrons to consider taxicabs as a transportation option for limited trips would need to be examined to determine if such an arrangement would increase local mobility. Not only would a specific "taxi zone" be identified, but perhaps dedicated hours during the workday as well.

Nevertheless, grassroots support for increased taxicab integration might influence local governmental officials that options for increased mobility already exists in the form of those yellow vehicles traversing Houston's city streets. The efforts for coordination must include all governmental entities, the public transit agencies, and civic and business groups. Through Federal initiatives and legislation communities have the ability to develop mobility programs that decrease congestion, improve mobility and improve the environment. Those yellow vehicles may be the answer.

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